

THE EAR

22 MAY 2013

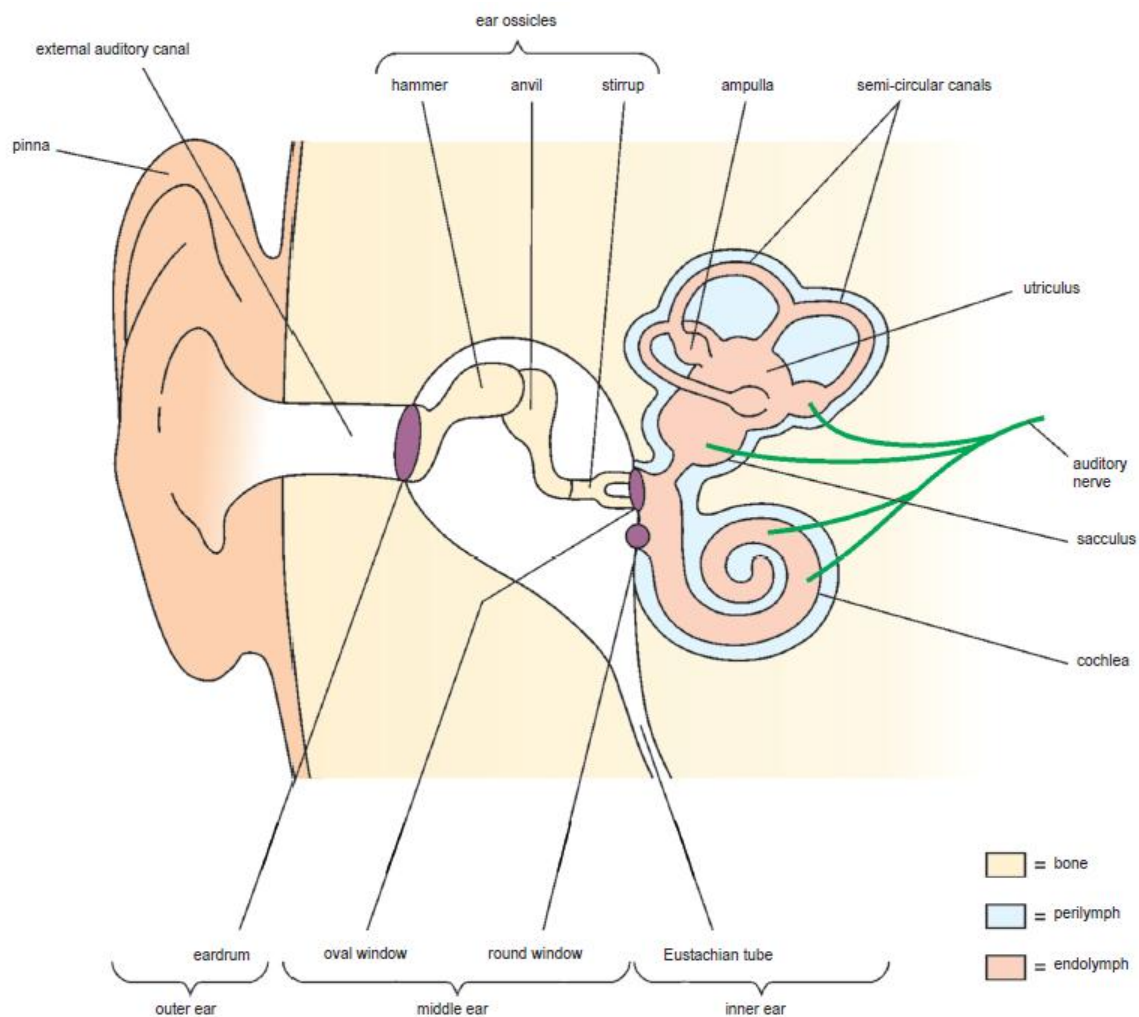
Lesson Description

In this lesson we:

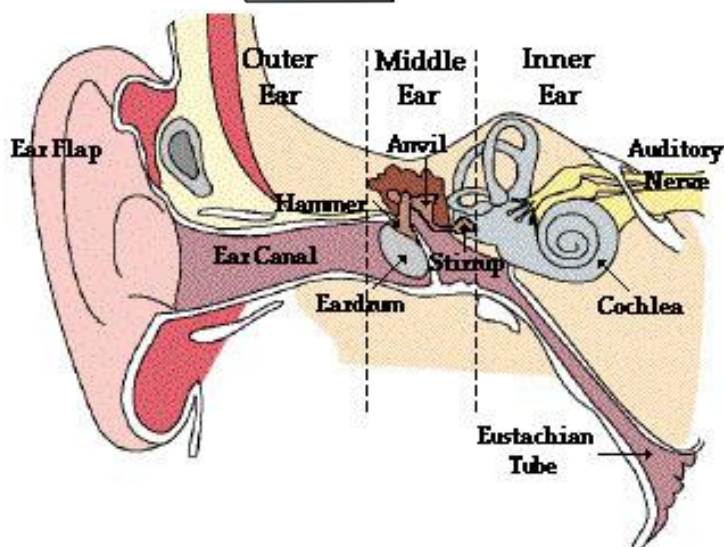
- Look at the structure and functions of the parts of the human ear.
- Discuss the adaptations of the various parts of the ear for their functions.
- Explain hearing and balance.
- Look at cause and treatment of the following hearing defects: Middle ear infections (treatment using grommets), deafness (treatment using hearing aids and cochlear implants).
- Look at the link between hearing defects and speech disorders.
- Discuss the use of sign language by deaf people.
- Discuss the attitudes towards blind and deaf people.
- Consider the rights of blind and deaf people.

Key Concepts

Structure and Functions of the Parts of the Human Ear

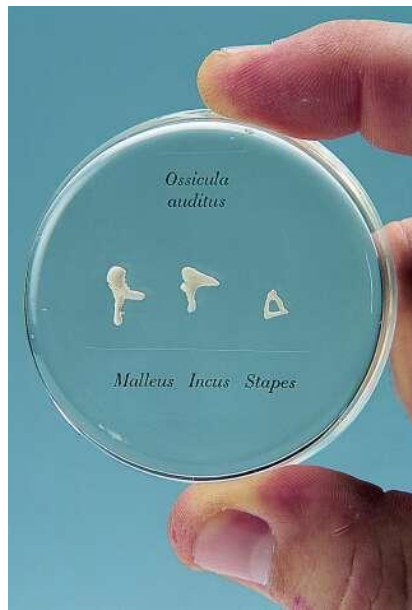


(Figure 2.28: Structure of the Ear Life Sciences for All, Grade 12, Macmillan, Page 74)



PART OF THE EAR	FUNCTION
Pinna	Picks up sound waves from the air and guides them into the auditory canal.
External Auditory Canal	Transmits sound waves from the pinna to the eardrum.
Eardrum/Tympanic Membrane	Transmits sound waves from the auditory canal to the ossicles (hammer).
Ear Ossicles (Hammer, Anvil and Stirrup)	Transmit sound waves from the tympanic membrane to the oval window. They also amplify sound waves.
Eustachian Tube	A tube that connects the middle ear with the pharynx. It equalises air pressure on either side of the eardrum.
Oval Window	Transmits sound waves from stirrup to the inner ear
Round Window	Absorbs excess sound waves.
Cochlea	Contains the organ of Corti which converts sound waves into nerve impulses
Utriculus and Sacculus	Able to detect changes in the position of the head with respect to gravity and are therefore involved in balance.
Semi-circular Canals	Able to detect the direction and rate of movement of the head and are therefore involved in balance.
Perilymph	The liquid that surrounds the membranous labyrinth in the inner ear.
Endolymph	The liquid that is found inside the membranous labyrinth of the inner ear.
Auditory Nerve	The nerve that carries nerve impulses from the ear to the brain.

The Ossicles of the Ear

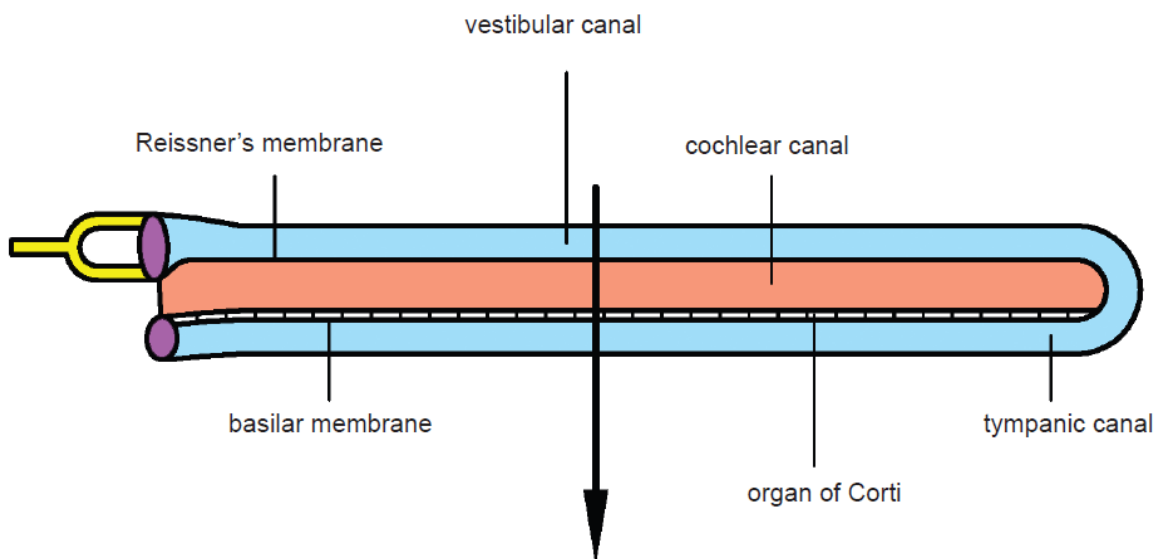


Hearing

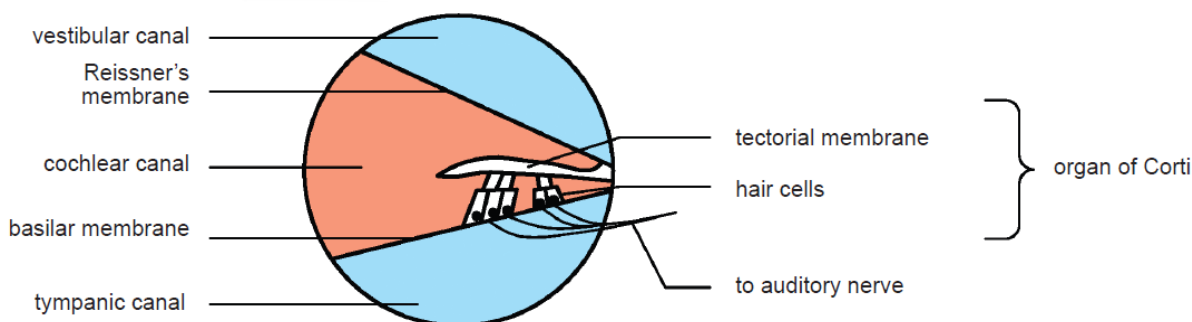
Overview

Pinna -----auditory canal -----tympanic membrane ---hammer ---anvil ---- stirrup ---- oval window----perilymph---organ of Corti---auditory canal ----brain

- Sound waves are trapped by the pinna
- Directed into the auditory canal
- Cause the eardrum to vibrate
- Which in turn causes the hammer, anvil and stirrup to vibrate
- This causes the oval window to vibrate



(Figure 2.29 (a): Longitudinal section through the cochlea, Life Sciences for All, Grade 12, Macmillan, p76)



(Figure 2.29 (b): Transverse section through the cochlea, *Life Sciences for All, Grade 12, Macmillan, p76*)

Sound waves are transmitted from the oval window into the perilymph of the vestibular canal, then through the endolymph of the cochlear canal which causes the basilar membrane to vibrate.

This causes the hair cells to vibrate (move up and down) and the hairs are deflected against the tectorial membrane.

When the hair cells touch the tectorial membrane the stimulus is converted to a nerve impulse that travels via the auditory nerve to the auditory area of the cerebrum of the brain.

Different parts of the organ of Corti respond to different frequencies of sound and the brain interprets the nerve impulse as a particular sound.

Balance

- Changes in direction and speed cause the endolymph of the semicircular canals, which are in three different planes, to move.
- The movement of the fluid stimulates the cristae in the ampullae – situated at the base of the semi circular canal.
- Gravitational pull stimulates maculae – in the sacculus and utricle, when the direction of the head changes
- The stimuli is converted to impulses within the cristae and maculae
- These impulses are sent to the brain by the vestibular branch of the auditory nerve to the cerebellum.

Other balance sensors

- Eyes
- Proprioceptors

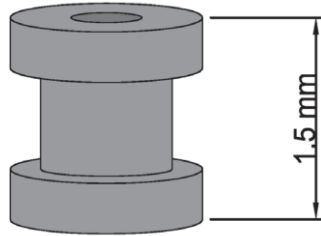
Hearing Disorders

Middle Ear Infections (Otitis Media)

- Caused by viruses and bacteria that cause common cold, influenza, etc.
- They cause inflammation of the middle ear.
- The fluid caused by the infection makes the Eustachian tube to be swollen, inflamed and clogged.
- Increasing pressure on either side of the ear drum – ear ache

Treatment:

- Successful treatment with medication
- Grommets are sometimes used to bypass the Eustachian tube and allow air to continuously enter the middle ear.

**Deafness****Caused by:**

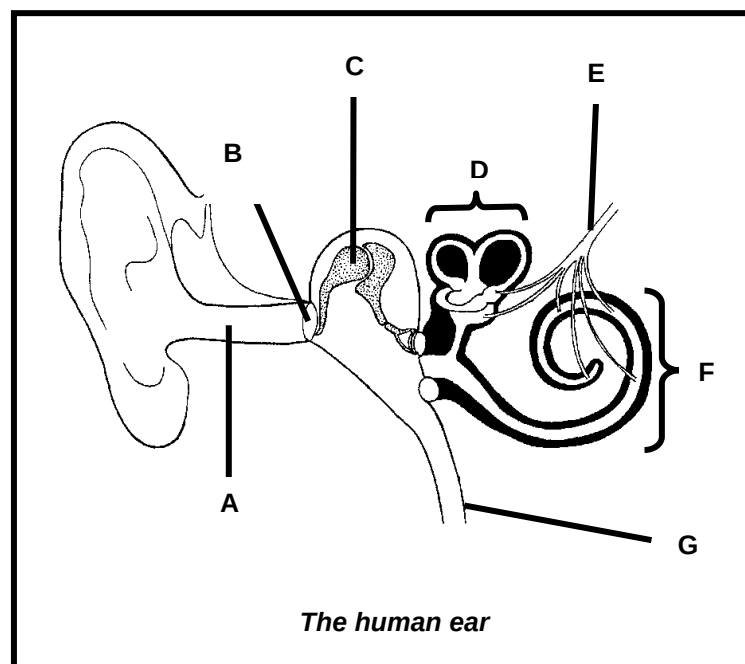
- Fluid in the middle ear
- The outer or middle ear not functioning properly
- Damage to the inner ear
- Damage to the part of the brain that perceives auditory impulses

Treatment:

- Medication, drainage of fluid
- Hearing aids – amplify sounds
- Cochlea implants – inside the ear – stimulates any functioning auditory nerves with electric field

Questions**Question 1**

Study the diagram and answer the questions that follow.



- a.) Identify the parts labelled B, C, D and F. (4)
- b.) Explain how the pinna of the ear is suited for its function. (2)
- c.) Write the **letter and the name** of the part which:
- Has receptors for balance (2)
 - Secretes a waxy substance called cerumen (2)
 - Equalizes pressure on either side of part B (2)
 - Transmits impulses to the brain (2)
 - Part in which the organ of Corti is found (1)
- d.) Explain what happens to sound waves from the time it is trapped to the time the sound waves are converted to an impulses. (10)

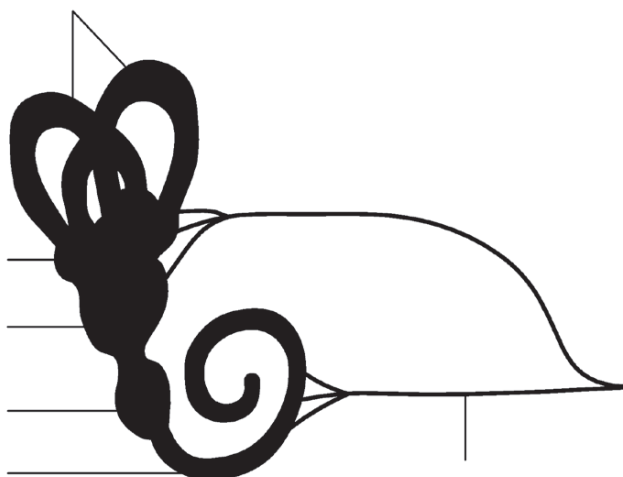
Question 2

Explain the

- a.) cause and (2)
- b.) treatment of middle ear infections. (2)

Question 3

The following diagram shows the membranous labyrinth of the inner ear.



(Figure 2.37, Page 83)

- a.) Provide labels for parts A–F.
- b.) Write down **only** the letter/s of the part:
- where you would expect to find a crista
 - where you would expect to find the organ of Corti
 - where you would expect to find a macula

- c.) How is this part of the ear protected?
- d.) Name the liquid that is found inside this part of the ear.

Question 4

The frequency of sound is measured in units called Hertz (Hz). James thinks that everyone has the same hearing. Saroj disagrees with James. She thinks that people have different hearing because James can hear things that Saroj can't hear. They decide to go to a special laboratory to have their hearing tested. The people at the laboratory measure the range of sound that the two learners can hear. The results are recorded in the following table.

	Lowest frequency of sound heard	Highest frequency of sound heard
James	19 Hz	20 300 Hz
Saroj	18 Hz	20 100 Hz

- a.) Why did Saroj think that people have different hearing?
- b.) What is the lowest frequency that James could hear?
- c.) What is the highest frequency that Saroj could hear?
- d.) Who could hear the largest range of sound?
- e.) What are the independent and dependent variables in the table?
- f.) Bats produce sounds between 30 000 and 80 000 Hz. Can we hear bats? Explain your answer.

Question 5

How does deafness affect speech?

Children who have been born deaf will have trouble speaking and producing sound as they have no point of reference. Deafness is therefore often linked with speech disorders.

How do (a.) deaf people and (b.) blind people communicate?

Question 6

What are the rights of blind and deaf people?

Links

- How do we hear a sound?
<http://www.youtube.com/watch?v=V3tdsIM7X5w>